ADAPTIVE MANAGEMENT AND THE COMPREHENSIVE EVERGLADES RESTORATION PLAN

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Abstract: The Comprehensive Everglades Restoration Plan (CERP) was authorized by the Water Resources Development Act (WRDA) of 2000 as a framework for the restoration, preservation, and protection of the South Florida ecosystem while providing for the other water-related needs of the region. CERP explicitly acknowledged shortfalls in achieving planning objectives that could not be addressed due to project constraints, risks and uncertainties, technological limitations and inadequate evaluation methodologies at that time. Given these constraints and the limited level of detail accomplished in the feasibility study, CERP deferred specific details for achieving planning objectives and long-term project implementation. Consequently, successful CERP implementation relies on effective adaptive management strategies. This article provides a brief overview of CERP, discusses the current adaptive management strategy and presents a case study, which highlights challenges and issues.

1. Background

Florida faces major water management challenges driven in large part by a state population that is projected to increase from nearly 16 million in the year 2000 to 26.5 million by 2030 [1]. The seasonal conditions in South Florida result in either too much or too little rainfall. This variability coupled with limited storage capacity causes water shortages, environmental degradation, and an average of 1.7 billion gallons of water a day lost to tide [2]. The Everglades is now considered to be the most threatened ecosystem in the nation [3].

The Central and Southern Florida (C&SF) Project Comprehensive Review Study, also known as the "Restudy," was authorized by Congress in 1992 to reexamine the C&SF Project and to determine the feasibility of modifying the project to restore the South Florida ecosystem while providing for other water-related needs of the region. The authorizing legislation required

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the study to investigate making structural or operational modifications to the C&SF Project for improving the quality of the environment; protecting water quality in the south Florida ecosystem; improving protection of the aquifer; improving the integrity, capability, and conservation of urban and agricultural water supplies; and improving other water-related purposes [3]. This study resulted in the authorization of the Comprehensive Everglades Restoration Plan (CERP). Currently estimated at $14.8 billion, CERP is the largest restoration initiative ever undertaken. CERP is composed of 68 major components that involve creation of approximately 217,000 acres of reservoirs and wetland-based water treatment areas, two wastewater reuse plants, seepage management, underground storage for approximately 1.6 billion gallons of water per day, and removal of more than 240 miles of levees and canals in natural areas [2]. Figure 1 illustrates the features of CERP.

These components vastly increase storage and water supply for the natural system, as well as for urban and agricultural needs, while maintaining current Central and Southern Florida Project purposes. CERP proposes to increase the water budget of the area from 1.7 billion gallons per day to 2.4 billion gallons per day. Specifically, the plan will improve the functioning of more than 2.4 million acres of the south Florida ecosystem; improve Lake Okeechobee water levels for littoral zone health; eliminate almost all damaging freshwater releases to the Caloosahatchee and St. Lucie estuaries; improve urban and agricultural water supply; improve water deliveries to Florida Bay, Biscayne Bay, and other estuaries; improve regional water quality conditions; and maintain existing levels of flood protection [1]. CERP remains a conceptual plan, however, and efforts to implement and execute this ambitious project are characterized by risk, uncertainty and debate. The scope and magnitude of CERP present obvious challenges in planning, policy making, and implementation. It is enormously difficult to characterize and assess progress toward ecosystem restoration at the large geographic and temporal scale of CERP.

2. Implementing CERP

WRDA 2000 authorized CERP as a framework, yet recognized the unparalleled technical uncertainties and political challenges. Given the level of detail provided in the authorized document, it was anticipated that CERP would be modified periodically to achieve its goals and purposes more effectively and precisely. Consequently, WRDA 2000 required the development of programmatic regulations to ensure that CERP goals and purposes are achieved and provided funding for an adaptive assessment and monitoring program. The programmatic regulations (33 CFR, Part 385) were promulgated in 2003 and establish a framework and process for

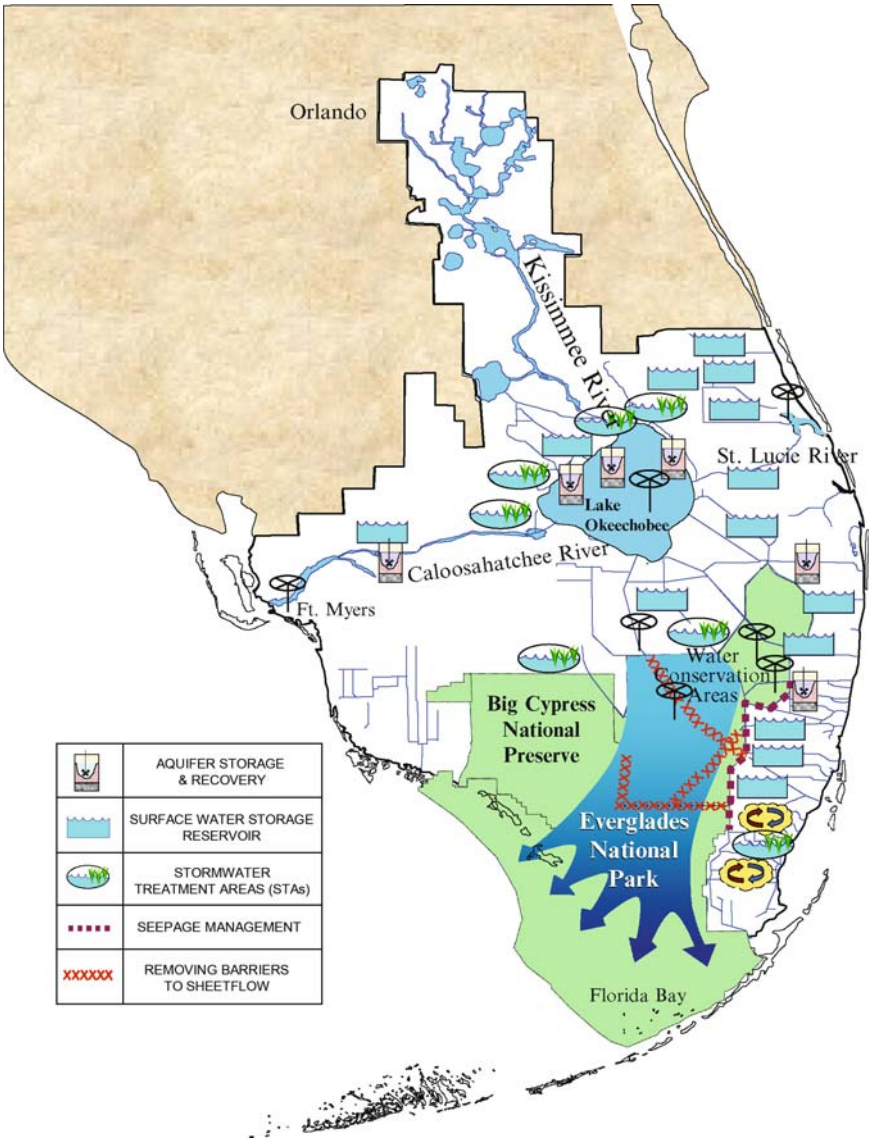

Figure 1. CERP Components.

integration of new information throughout CERP's 30-year implementation. Plan modifications and refinements recommended based on new and/or improved information were to be achieved through individual project implementation reports (PIRs), systemwide monitoring, and assessment strategies.

2.1. PROJECT IMPLEMENTATION REPORTS

The CERP program is composed of 68 major components that are grouped into more than 40 projects. Each project is developed by an interagency, multidisciplinary team responsible each project's PIR. The programmatic regulations require that the PIRs:

> formulate and evaluate alternative plans to optimize the project's contributions towards achieving the goals and purposes of the Plan, and to develop justified and cost effective ways to achieve the benefits of the Plan.

Interim guidance has been developed to assist project delivery teams (PDTs) in the plan formulation activities during the development of a PIR. The guidance provides a means of formulating projects while maintaining a system perspective. The guidance identifies the goal of CERP formulation and evaluation as to "reasonably maximize the project's contribution toward the system-wide benefits of CERP compared to cost."

Further, the interim guidance directs PDTs to formulate alternative projects to better define, refine, and/or optimize projects and/or to investigate more cost-effective ways to achieve the same or greater benefits at a lesser cost compared to that predicted for CERP identified by the Restudy. While this guidance generally captures the intent of the Programmatic Regulations, it does not define a process that would encourage or even allow PDTs to investigate alternative projects outside their project boundaries to achieve CERP benefits at a lower cost.

2.2. SYSTEMWIDE AND PROJECT-LEVEL ANALYSIS

The benefit and impact analysis conducted for each CERP project is accomplished at both the local and systemwide scale. For example, a reservoir project could have adverse impacts to wetlands within the footprint of the project while the storage function of the reservoir (in combination with other CERP features) could have significant ecologic benefits by restoring sheetflow across vast areas of the Everglades and downstream estuaries. The impacted wetlands are generally considered a local effect, while the ecological benefits to the Everglades and downstream estuaries are considered systemwide effects. Regional models are used to assess impacts to sheetflow and estuaries, while subregional models are used to assess impacts to the footprint and in the vicinity of the project. Figure 2 displays the terms used for system and project level analysis.

2.3. CERP ADAPTIVE MANAGEMENT STRATEGY

CERP was designed to facilitate project modifications based on lessons learned from system responses, both expected and unexpected, and from future restoration targets as those become more refined. CERP includes

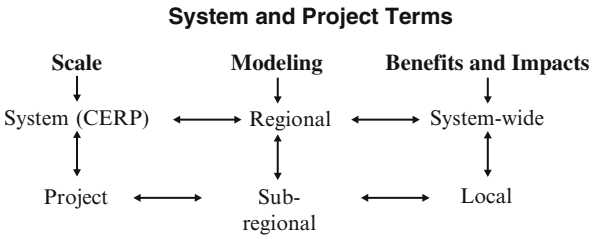

Figure 2. CERP Components.

an adaptive management strategy to ensure that new information about the natural system, learned from continuing research and from measuring responses to implementation of plan components. CERP can be used to reduce gaps and increase the level of success without significant increases in implementation costs. Specifically, adaptive assessment uses a well focused, regional monitoring program to measure how well each CERP component accomplishes its objectives. This, in turn, sets up opportunities for refinement of succeeding components. Such adaptive assessment and regional monitoring are essential features of CERP. Various documents have been developed by RECOVER[1] to frame the adaptive assessment program for CERP. For more information on CERP's adaptive management strategies, see the Comprehensive Everglades Restoration Plan Adaptive Management Strategy [4].

Adaptive management is a science- and performance-based approach to ecosystem management in situations where predicted outcomes have a high level of uncertainty [4]. Adaptive management has been an integral component of CERP. The Restudy identified specific shortfalls which were to be addressed during plan refinement in order to fully achieve CERP planning objectives [2].

The RECOVER team is responsible for the development and implementation of the CERP Adaptive Management Program. This program comprises four elements: CERP planning, performance assessment, update process, and management and science integration. Figure 3 displays these four elements and their relationships.

[1] The Restoration Coordination and Verification (RECOVER) team ensures the application of scientific and technical information in ways that are most effective in supporting the objectives of CERP.

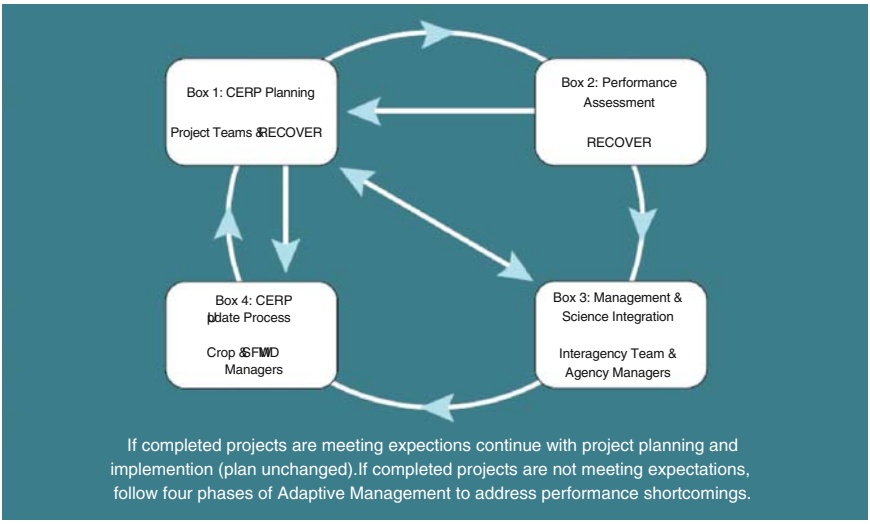

Figure 3. CERP Adaptive Management Framework [4].

3. Case Study: Application of Adaptive Management in CERP

The Restudy identified the array of components necessary to achieve the Everglades' restoration and other water resources objectives based on information available at that time. However, there are shortfalls in the plan that could not be addressed due to project constraints, risks and uncertainties, and the limits of knowledge, technology and evaluation methodologies at that time. Currently, the established objectives fall short of targeted levels by a significant amount: 40–90%.

To help address these shortfalls, it is essential that the original guiding principles that framed the vision be viewed in the context of CERP's potential role in achieving objectives and maintaining flexibility for more effective and efficient implementation. The guiding principles state:

Project Delivery Teams and RECOVER will actively coordinate in the formulation and evaluation of project designs, in order to identify the plans that can improve on the predicted performance of the version of the Plan approved in 1999. The success of CERP will depend on a thorough understanding of the relationships between the contribution of each project and the overall goals of the Plan. [5]

Further,

CERP implementation will include the application of a system-wide science strategy and adaptive management program, designed to maximize the effective use of existing knowledge and incorporate new scientific and technical information, as a basis for continually improving the design, operation and performance of the Plan. [5]

From these guiding principles, success in reducing CERP's shortfalls based on achieving the established objectives is contingent on three important factors:

1. Successful identification of system solutions to problems through system planning
2. Effective design and implementation of appropriate restoration projects and
3. Comprehensive monitoring or tracking of improvements and shortfalls toward the desired goals and targets, which can be used to make adjustments to the plan and to reach agreement on objectives and priorities

While WRDA 2000 approved CERP, it is expected that the plan will be modified periodically to achieve its goals and purposes more effectively and precisely. These modifications and refinements were to be achieved initially through the PIRs and later systemwide monitoring and assessment strategies. Therefore, addressing CERP shortfalls during planning of CERP projects is key to immediately improving plan performance. Individual project teams must look for creative opportunities to address the critical shortfalls. Ultimately it is the PDTs, working with RECOVER, that will identify cost-effective means of achieving the restoration objectives. For example, one of the shortfalls identified during the Restudy was achievement of the restoration target for the St. Lucie Estuary. Consequently, the IRL-South PDT reevaluated alternative plans and identified a project that significantly improved CERP performance within the St. Lucie Estuary. In addition, the project addressed the spatial extent shortfall by restoring wetland areas within the drainage basin of the estuary. This innovative approach reduced the amount of reservoir and stormwater treatment areas needed for the project while significantly contributing to the spatial extent objective.

However, the mechanisms in place to deal with recommendations for plan improvements outside project boundaries do not appear to be functioning. For example, 100,000 acre-feet of additional water was found in the course of preparing the Indian River Lagoon-South (IRL-S) PIR [6] but was not utilized in either the PIR or subsequently, to date, through an adaptive management strategy by RECOVER. While the intent of the IRL-S PDT was to support the goal of systematically improving CERP based on new information, it appears that the current implementation process falls short in supporting plan improvements.

4. Conclusions

Restoration of what remains of the Everglades ecosystems represents one of the most ambitious ecosystem restoration initiatives ever conceived [7]. Despite significant progress in program management, scientific understanding, and project evaluations, no CERP projects have been completed to date. Budgetary constraints coupled with scientific and technical uncertainties have caused significant delays in project implementation. Moreover, federal funding, inflation, and unanticipated coordination costs contribute to increased scrutiny, additional reporting requirements and skepticism among the extensive consortium of partners and stakeholders. NRC [7] has completed a review of the progress in restoring the Everglades and has determined that the monitoring and assessment plan documents describe a well designed, statistically defensible monitoring program and an ambitious assessment strategy. However, implementation of the monitoring plan is occurring more slowly than planned. A coordinated approach is necessary to improve modeling tools and focus modeling efforts toward direct support of the CERP adaptive management process. Astute monitoring coupled with effective and timely response and refinement is key to the successful implementation of the plan.

Consistent with recommendations from the National Research Council [7], an Incremental Adaptive Restoration Strategy to formulate projects within CERP and address some of the issues encountered with CERP implementation has been developed. The current draft is available for online review [8].

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